

Ancient Viruses from Extreme Environments?

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Previously characterized viruses of hyperthermophilic Archaea are unlike any known virus both in their morphology and genome sequences. The virus STIV (Sulfolobus turreted icosahedral virus) was discovered in a hot spring at 80°C and pH 3.5 in the Rabbit Creek thermal area in Yellowstone National Park. The double stranded DNA genome of this virus contains very few ORFs with detectable similarity to known sequences. Unlike other viruses of hyperthermophilic Archaea, the virion has a clearly icosahedral structure with symmetrical prominent mushroom-like projections and novel T=31 icosahedral symmetry. A high-resolution structure was determined by cryo-electron microscopy and image reconstruction. The structure of the major coat protein is strikingly similar to the structure of PRD1 from Bacteria and adenovirus from animals, even though the structural protein genes show no sequence similarity. The three dimensional structures derived from X-ray crystallography of both the PRD1 coat protein and adenovirus hexon protein fit extremely well into the STIV structure. We believe that this indicates a common ancestor for these viruses from the three domains of life, unprecedented horizontal gene transfer or potentially massively convergent evolution. All of these have profound implications for Astrovirology.